HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - NOVEMBER 1990

Data for this review have been provided principally by the regional divisions of the National Rivers Authority (NRA) in England and Wales, the River Purification Boards in Scotland (RPBs) and by the Meteorological Office. The recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a significant proportion of the river flow data may be subject to review.

For a full appreciation of the water resources implications, the data provided in this hydrological review should be considered alongside assessments of the current reservoir storage and water demand situations in each region. Reservoir storage data, supplied by South West Water, are presented for the first time in the Hydrological Summary. It is envisaged that a more comprehensive coverage will be provided in future editions.

A map (Figure 5) is provided to assist in the location of monitoring sites.

Summary

The unsettled complexion to the weather throughout much of November failed to translate into substantial rainfall over large parts of Great Britain and an increase in the regional variations in drought intensity was evident. No notable droughts remain in Scotland at the regional scale and, notwithstanding the limited late-autumn rainfall, precipitation totals for the year thus far are very high. By contrast, in England an exceptionally severe nine-month drought may be recognised in the Thames NRA region and very notable rainfall deficiencies extend into the neighbouring regions, Anglian and Wessex especially. Medium term deficiencies (10-18 months) are generally modest but important long term deficiencies may still be identified particularly in eastern and southern England.

Generally, November river flows were well below average but remained above historical minima, except in baseflow dominated rivers in parts of the east, the Midlands and central southern England. Commonly, runoff rates were similar to those for November 1989. Accumulated runoff totals for the period beginning in April are remarkably low in a large proportion of eastern and southern Britain.

No general recovery in groundwater levels is yet evident; localised and moderate increases only have been reported. The sustained and largely uninterrupted recessions since late February, coupled with the limited recharge in many areas since the end of the 1987/88 winter, have resulted in very depressed water-tables throughout all major aquifers. Over wide areas the groundwater situation is comparable to the beginning of winter in 1989 but in the east - and in some central districts - groundwater levels have declined to absolute minima in records extending over 30 years or more.

For the third successive year, the water resources outlook at the end of the autumn is fragile over large parts of England. The soil moisture deficits (SMDs) built up through the hot and dry summer robbed this year's autumn rainfall of much of its effectiveness particularly in the lowlands. As a consequence, substantially above average rainfall will be required over the December-April period to generate increases in runoff and, especially, recharge rates of sufficient magnitude to ensure that river flows and groundwater levels are within the normal range by the spring. The very depressed levels from which a groundwater recovery will need to be generated are a matter of concern over the greater part of lowland England - aquifer recharge will need to be sustained well into the late-spring if groundwater resources are to be well placed to resist another hot, dry summer in 1991.

Rainfall

Cyclonic conditions were a common feature of the November weather but they did not exhibit the vigour which may be expected towards the end of the year. In central southern and parts of northern Britain rainfall tended to be in the form of light showers or intermittent episodes of drizzle rather than the sustained frontal rainfall which, on average, makes November one of the wettest, if not the wettest, months of the year.

Frontal activity in and around the North Sea made an exception of some eastern coastal areas south of the Humber, where the November rainfall total was significantly above average. Elsewhere, rainfall was appreciably below the 1941-70 mean - a few districts, mostly in the Thames Valley and parts of Wessex, received less than 40% of average; much of northern Britain was also relatively dry. Autumn (September-November) rainfall totals are generally below the average but within the normal range in all regions. The persistence of substantial longer term deficiences testify to the remarkable dryness of the spring (especially) and the summer.

For England and Wales as a whole the provisional March to November rainfall total was the lowest in the entire general rainfall series (beginning in 1766) with the exception of 1921. For the Thames Valley, the nine-month accumulation is even more extreme; each of the individual monthly rainfall totals was below average and the March-November catchment rainfall total is the lowest on record by a considerable margin - the 1921 total is the only one to come within 100 mm of the 281 mm (provisional) registered this year. Considering ***any*** nine-month period there are only five drier sequences (three of which occurred during the 1975/76 drought) in the 107-year record. The Institute of Hydrology's raingauge (at Wallingford) was one of a number in central southern England recording less than half the average rainfall over the March-November period. Table 2 emphasises the regional nature of the meteorological drought in this timeframe. The extraordinary transformation in weather patterns around the end of the 1989/90 winter is reflected in the very modest return periods for the rainfall over the last 12 months. For the Thames, Southern, Wessex and South-West NRA regions winter (December-February) precipitation exceeds that for the ensuing nine-months; a remarkable temporal contrast given the normal, fairly even, rainfall distribution throughout Great Britain.

In addition to those regions where the 1990 rainfall deficiency is currently most acute, longer term droughts may also be recognised along the eastern seaboard and across southern England. Where these droughts incorporate below average rainfall in the winters of 1988/89 and 1989/90 - for instance in parts of Yorkshire, Humberside, Lincolnshire, East Anglia and Kent, the effect on groundwater resources has been severe (see below).

Evaporation and Soil Moisture Deficits

Although less remarkable than many recent months, sunshine hours and temperatures were still a little above average throughout the greater part of the UK in November. Correspondingly evaporation rates were greater than normal and PE losses this year appear likely to match or exceed the records established in 1989. The AE picture is more complex with evaporation losses being inhibited by the large SMDs prevalent since April.

By the end of November soils were at, or close to, field capacity throughout much of northern and western Britain. Towards the English lowlands a sharp transition takes place with large deficits (notably so relative to the long term average) typifying much of central England and parts of the north-eastern lowlands. Very high deficits - in excess of 80 mm - characterise parts of the Thames Valley; long term records indicate that the late-November SMDs in some districts are unprecedented over a 70-year period - spatial variability is considerable also. Along England's south-eastern coastline, the November rainfall was noticeably beneficial and in Norfolk and Suffolk late-autumn SMDs were close to the long term average. Except in such eastern districts, end of November SMDs were generally a little lower than those of 1989 but exceptions could be seen in the drier soils of the Cotswolds, parts of Wessex and central southern England.

In terms of the water resources outlook it is important that the remaining SMDs be smartly reduced so that the aquifer recharge period, especially in eastern districts, is not severely restricted over the 1990/91 winter - recharge may be expected to cease as evaporation rates climb through the spring.

Runoff

Notwithstanding the declining evaporative losses, the seasonal recoveries in river flows evident in October - at least in impermeable catchments - were not reinforced in November, apart from rivers in the South-West and in a few other catchments. Runoff totals for the month were well below average throughout almost all of Great Britain with many eastern and southern catchments recording less than half the long term average. In the more maritime regions runoff totals, whilst modest, were substantially greater than in other recent autumn droughts (e.g. those of 1983, 1978, 1975 and 1972) and, over wide areas, were broadly comparable with 1989. On the other hand, many baseflow dominated rivers in the English lowlands - and some other areas, notably the Yorkshire Wolds and North York Moors - remain at very depressed flow rates. Using the November mean flows as a yardstick, the 1990 hydrological drought is most severe in the Thames NRA region. Runoff in November was the lowest in a 28-year record for the Coln which drains the dip-slope of the Cotswolds. The Thames at Kingston registered its lowest naturalised mean flow (for November) since 1947. Exceptionally low flows were also recorded on the Kennet and the Mimram and on other Chalk rivers beyond the Thames Valley - the Itchen (Hampshire) and Lud (Lincolnshire) being notable examples.

With the exception of rivers in the the Thames and Wessex NRA regions, return periods associated with the November flow rates are generally less than twenty years or so; in part this is a reflection of the moderating influence of the very low runoff totals for November 1988 and 1989 upon the flow frequency analyses.

Accumulated runoff totals remain very depressed throughout the major part of Great Britain. Over the autumn (September-November) mean flows have been especially low in the Wessex, Southern, Anglian and - particularly - the Thames NRA regions; very modest totals also characterise a number of predominantly permeable catchments to the north of the Humber. The most meaningful indices of current drought severity are probably the runoff accumulations since April (Table 3). Many lowland rivers have recorded below average flows in each of the eight months and accumulated deficiencies of greater than 50% are common. The eight-month runoff total for the Thames is the lowest since the 1934 drought (this is true also of each of the 3 to 7-month accumulations ending in November). Return periods in excess of 20 years (for the eight-month accumulations) also characterise a number of rivers with limited baseflow support in lowland Britain and a few less responsive southern and eastern rivers (e.g. in parts of the Yorkshire NRA region).

The effect of the abundant runoff over the 1989/90 winter (December-February) is evident from the 12-month runoff totals listed in Table 3; those with accumulations less than about 70% of the LTA help identify the regions of maximum hydrological stress - parts of Yorkshire, Humberside, East Anglia and large parts of central and southern England. The transformation in runoff conditions through 1990 has no recent parallel but on the Thames (for instance) the overall recession in 1947 - from a notable monthly peak in March - embraced a significantly wider flow range than has been experienced this year.

From mid-October runoff to gravity-fed impoundments in the west has produced a healthy measure of replenishment - see, for example, Figure 3. Elsewhere improvements in reservoir stocks have been generally marginal. In Wessex, for instance, overall storage is appreciably less than at the end of the 1989 drought.

Groundwater

The recession of groundwater levels has continued through November with little if any significant recharge. Even away from the eastern seaboard, upturns (at the BGS index sites) have been observed only in one Carboniferous Limestone well and in a few observation boreholes along the south coast and in the far south-west. Modest increases have also been reported for parts of Wessex and Kent but generally water-tables remain exceptionally low throughout all major aquifers.

The limited rainfall in November has caused an increase in drought severity as indexed by the groundwater levels in nationally monitored wells and boreholes. The data in Table 4 show that, at seven of the index sites listed, groundwater levels are below the minimum recorded November levels, while at five sites the levels are the lowest ever recorded. At the Dalton Holme site (in the Chalk of the Yorkshire Wolds) groundwater levels continue to decline below the previous minimum (in a 101-year record) and now stand about 4.5 metres below the end-of-autumn mean level; a rise of nine metres would be required to bring levels back to the monthly average by March.

Gentle recessions through into early December have left water-tables over large parts of England at an unprecedented level, albeit often only a little below the corresponding levels in 1989. In parts of Yorkshire, Humberside, Lincolnshire, East Anglia and southern England, groundwater levels have fallen below the minima established at the end of the 1976 drought. A particularly dramatic decline in levels through the autumn was registered at the Ampney Crucis site (in the Middle Jurassic Limestones); levels remained below the preceding minimum throughout November and the magnitude of the fall since late-February has no close precedent in a 32-year record.

With groundwater levels over wide areas below the early-winter average by amounts greater than the mean annual fluctuation, the prospects of restoring water-tables to the normal spring level are poor. In excess of 150% of average precipitation over the winter and early spring will be required in some southern and eastern areas. The temporal distribution will also be important - the benefits of even exceptionally heavy winter rainfall will be considerably diminished if, as in 1990, a very dry episode in March/April produces an early, and steep, resumptiom in water-table recessions.

Institute of Hydrology / British Geological survey

13 December 1990

TABLE 1 1989/90 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Oct 1989	Nov	Dec	Jan 1990	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
England and	mm	98	61	134	133	142	23	38	25	72	35	45	50	100	70
Wales	%	118	63	149	154	219	39	66	37	118	47	50	60	120	72
NRA REGIONS															
North West	mm	145	84	100	197	193	45	57	49	99	58	68	81	164	72
	%	123	69	83	176	238	63	74	60	119	56	54	66	139	60
Northumbria	mm	71	35	75	112	135	32	25	51	69	40	53	53	106	54
	%	95	37	100	140	205	62	45	80	113	52	52	66	141	57
Severn Trent	mm	82	52	135	106	109	18	30	19	63	27	37	47	93	52
	%	126	66	193	154	206	35	58	30	113	42	46	70	143	66
Yorkshire	mm	77	45	98	118	112	23	25	29	82	32	46	39	92	47
	%	112	51	132	153	175	43	45	48	141	46	51	54	133	53
Anglia	mm	41	36	98	52	75	15	34	16	45	21	31	32	51	53
	%	79	58	185	101	179	38	85	34	92	37	48	62	98	85
Thames	mm	65	37	141	92	114	12	35	7	47	17	35	34	59	34
	%	102	51	214	148	242	26	76	13	90	28	50	55	91	47
Southern	mm	79	50	142	121	136	6	48	10	61	13	33	38	105	63
	%	101	53	175	159	237	12	100	18	122	22	45	54	135	67
Wessex	mm	101	58	165	124	158	14	35	11	62	31	41	48	87	52
	%	123	60	183	147	268	24	65	16	115	50	50	61	106	54
South West	mm	148	100	196	195	238	25	46	25	99	61	59	68	126	100
	%	131	75	145	151	264	30	65	30	152	73	58	65	112	75
Welsh	mm	180	109	199	240	215	37	48	34	98	53	65	85	149	110
	%	140	76	137	176	224	43	56	37	120	56	55	68	116	77
Scotland	mm	187	60	96	250	294	247	96	66	156	83	119	147	211	113
	%	126	42	62	182	283	268	107	73	170	74	92	107	142	80
RIVER PURIFICATION BOARDS															
Highland	mm	258	79	109	293	365	409	136	54	136	95	157	230	220	147
	%	139	47	56	179	274	359	119	52	124	75	106	146	118	87
North-East	mm	87	29	54	108	149	87	45	48	105	47	79	85	138	93
	%	90	28	53	119	201	140	74	62	150	51	74	98	142	90
Tay	mm	136	51	86	239	287	178	61	43	123	39	74	67	187	86
	%	111	43	64	203	288	217	81	45	148	38	63	58	153	72
Forth	mm	112	39	79	222	222	142	55	39	121	51	81	65	185	70
	%	106	36	72	224	288	206	81	46	161	52	70	60	175	65
Tweed	mm	68	30	78	167	178	52	31	46	103	54	61	68	159	85
	%	77	29	87	180	258	90	51	61	151	61	54	73	181	82
Solway	mm	145	59	119	254	285	94	72	77	111	75	105	81	216	62
	%	101	41	79	181	306	103	82	84	123	68	82	54	150	43
Clyde	mm	244	73	107	316	341	295	127	57	134	95	149	173	297	95
	%	133	44	58	196	302	281	123	59	130	73	105	99	162	57

Note: November figures for England and Wales for 1990 are based upon MORECS figures supplied by the Meteorological Office
Scottish RPB data for November 1990 are estimated from the isohyetal map of November rainfall in the MORECS bulletin. The Scottish national value was provided by the London Weather Centre.

TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		MAR - NOV 90	Est Return Period, years	DEC 89 - NOV 90	Est Return Period, years	MAY 89 - NOV 90	Est Return Period, years	NOV 88 - NOV 90	Est Return Period, years
England and Wales	mm	458		867		1238		1644	
	% LTA	68	60-80	95	2-5	84	10-20	86	15-20
NRA REGIONS									
North West	mm	693		1183		1709		2343	
	% LTA	77	15-20	97	2-5	87	5-10	92	2-5
Northumbrian	mm	483		805		1100		1464	
	% LTA	73	20-30	92	2-5	77	50-60	79	60-80
Severn Trent	mm	386		736		1070		1399	
	% LTA	66	50-60	95	2-5	86	5-10	86	10-15
Yorkshire	mm	415		743		1057		1412	
	% LTA	67	50-70	89	2-5	79	30-40	80	40-60
Anglia	mm	298		523		776		1023	
	% LTA	64	90-100	86	5-10	78	40-50	80	40-50
Thames	mm	280		627		891		1175	
	% LTA	53	>200	89	2-5	78	20-30	79	40-50
Southern	mm	377		776		1045		1352	
	% LTA	65	40-60	98	2-5	82	10-20	80	30-40
Wessex	mm	381		828		1169		1528	
	% LTA	60	90-110	95	2-5	84	10	83	15-20
South West	mm	609		1238		1738		2277	
	% LTA	73	15-25	104	2-5	93	2-5	90	2-5
Welsh	mm	679		1333		1915		2558	
	% LTA	71	30-40	100	<2	90	5-10	91	5-10
Scotland	mm	1238		1878		2584		3528	
	% LTA	120	15-20	131	>200	113	15-20	117	60-80
RIVER PURIFICATION BOARDS									
Highland	mm	1584		2351		3351		4563	
	% LTA	129	20-30	137	>>200	119	40-60	126	>>200
North-East	mm	727		1038		1434		1853	
	% LTA	96	2-5	101	2-5	87	10-15	86	15-25
Tay	mm	858		1470		2010		2759	
	% LTA	94	2-5	117	10	100	<2	105	2-5
Forth	mm	809		1332		1823		2467	
	% LTA	97	2-5	119	15-20	101	2-5	105	2-5
Tweed	mm	659		1082		1457		1904	
	% LTA	88	2-5	108	2-5	89	5-10	90	5-10
Solway	mm	893		1551		2156		2956	
	% LTA	86	5-10	109	2-5	94	2-5	99	<2
Clyde	mm	1422		2186		3074		4185	
	% LTA	118	10	131	150-170	115	15-20	120	90-110

Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

* Tabony, R C, 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office (HMSO).

FIGURE 1. MONTHLY RAINFALL FOR 1989-1990 AS A PERCENTAGE OF THE 1941-1970 AVERAGE FOR ENGLAND AND WALES, SCOTLAND, AND THE NRA REGIONS

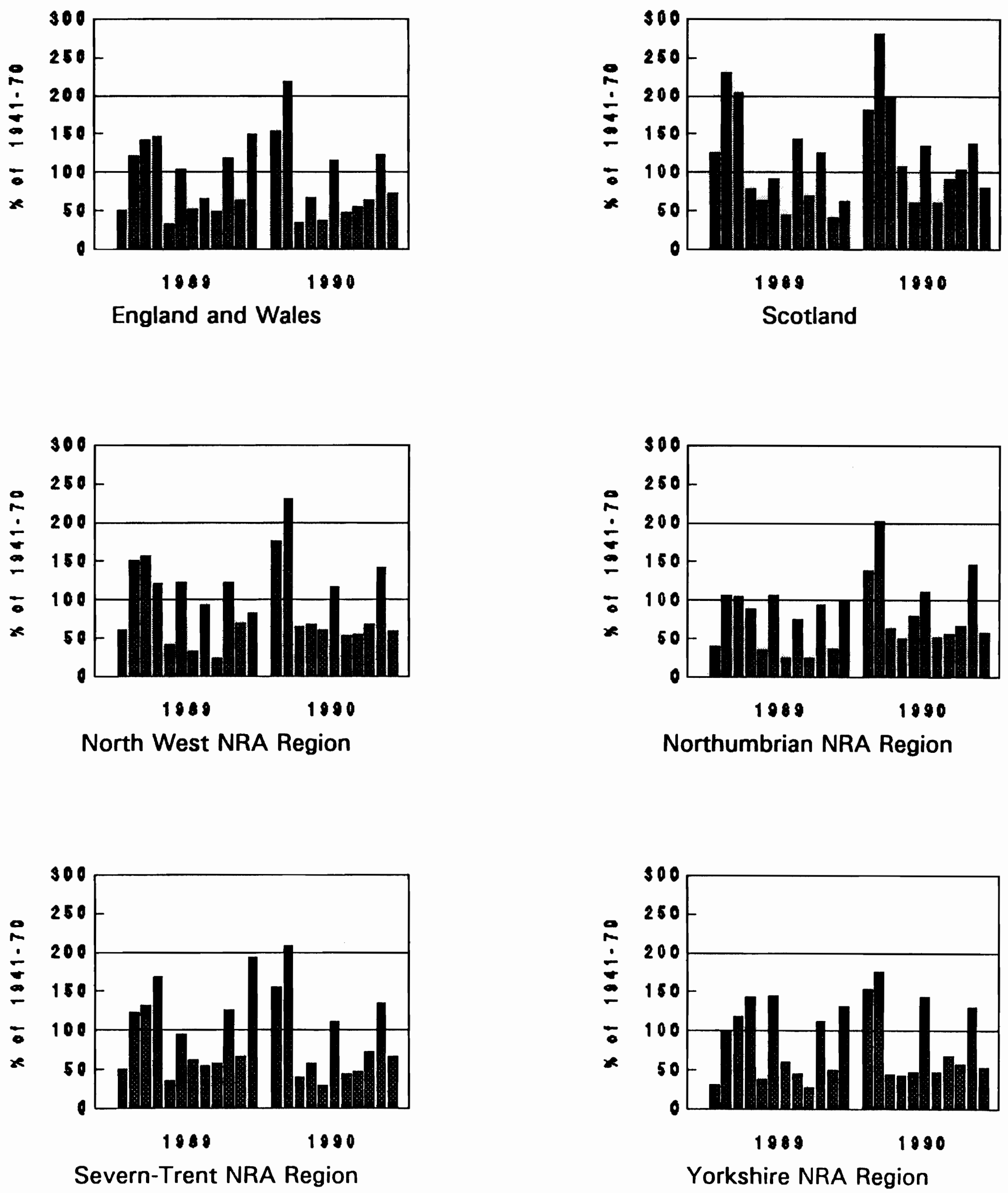


FIGURE 1 (continued)

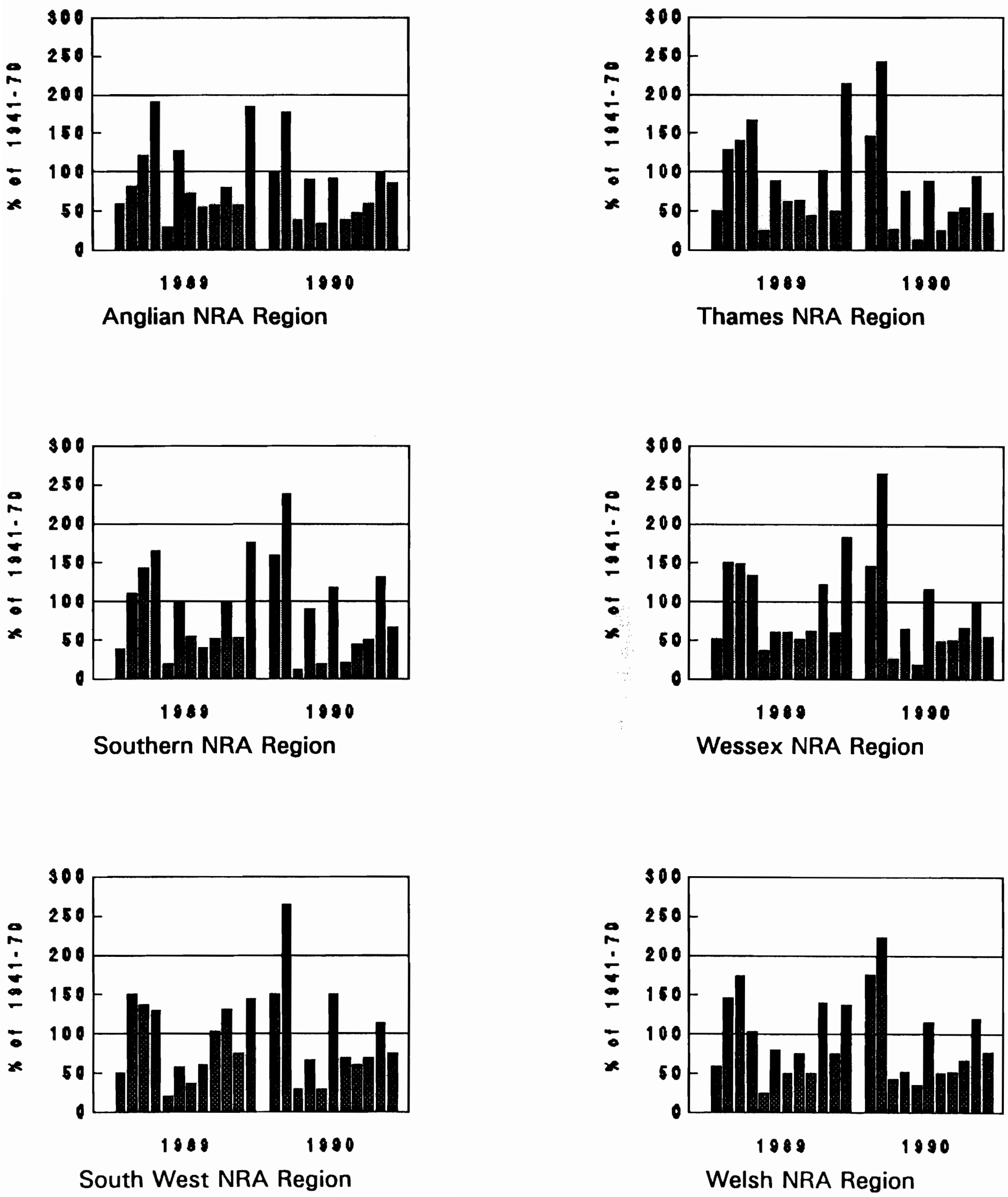
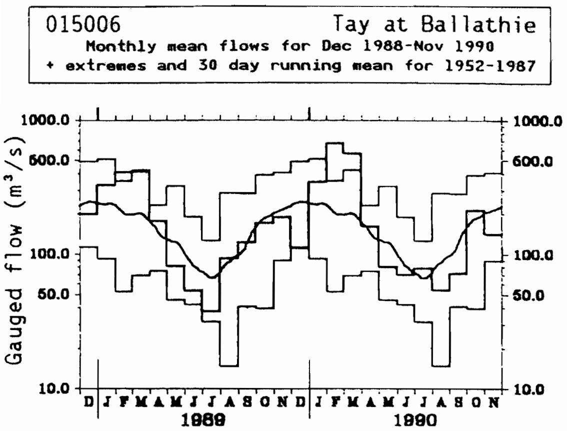
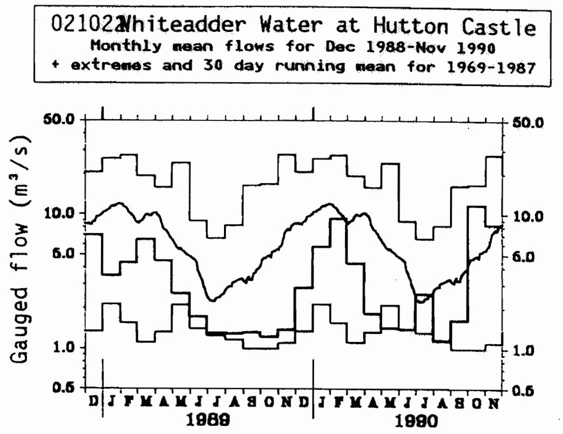
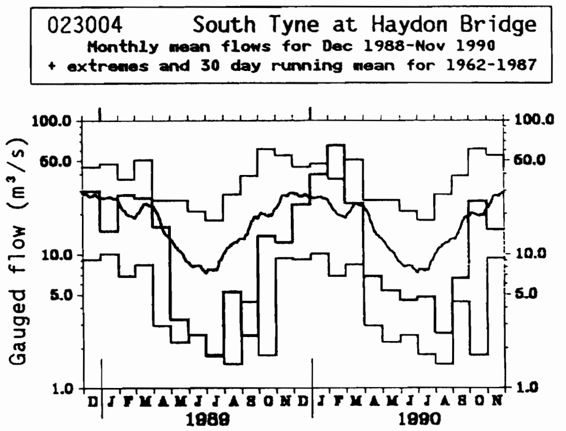
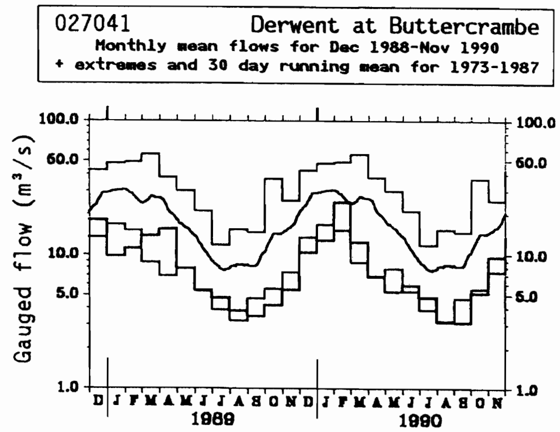


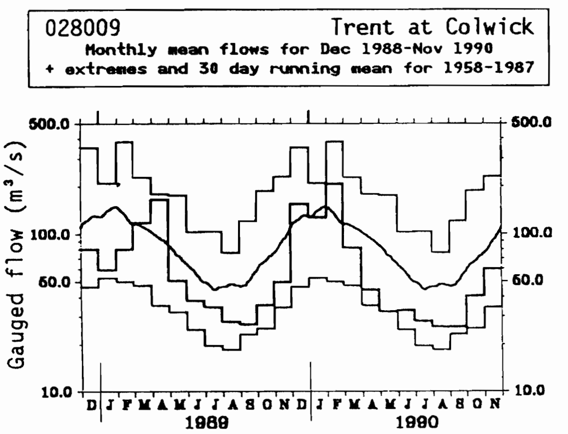
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

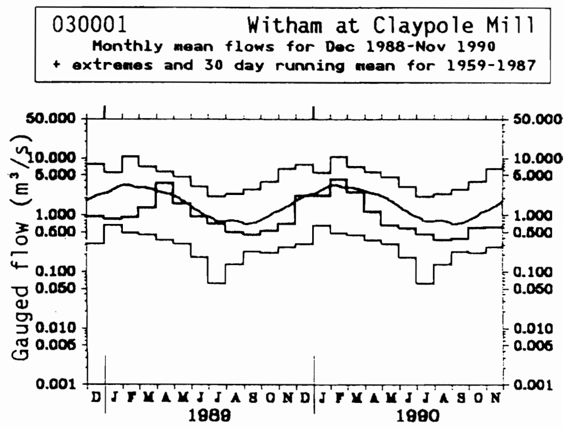


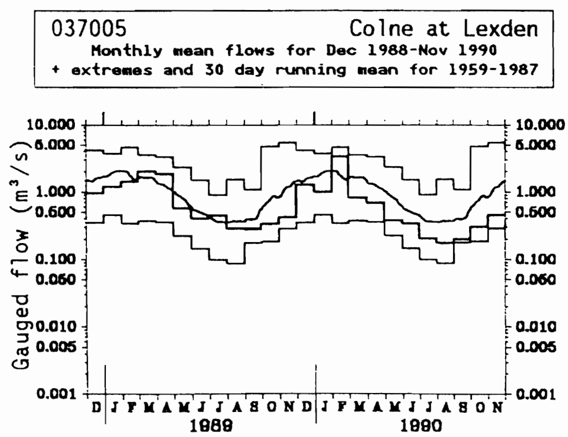


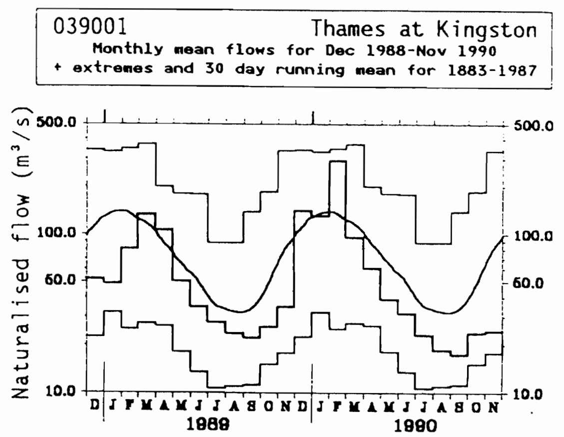




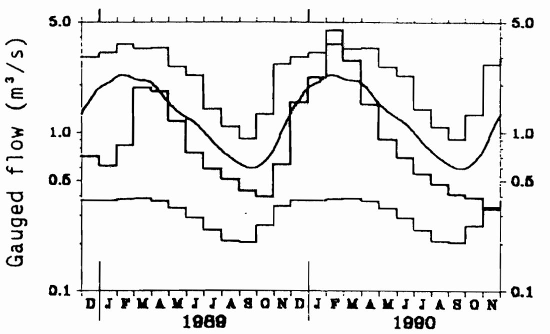




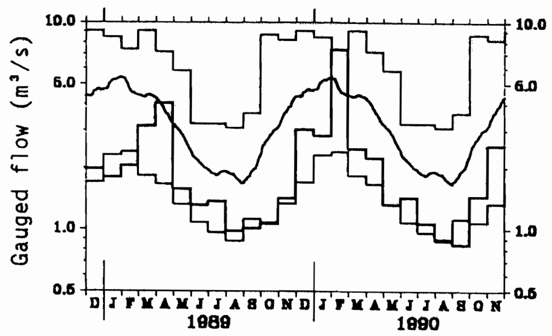




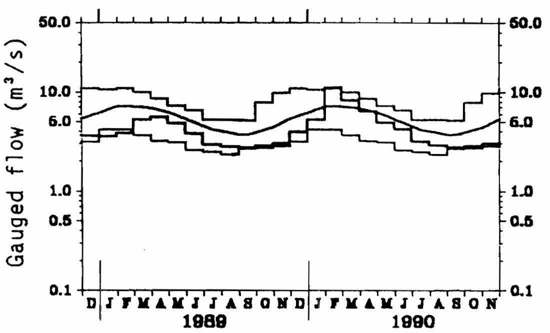
039020 Coln at Bibury
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1963-1987



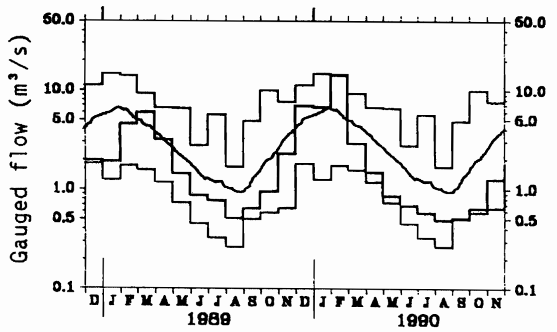
040011 Great Stour at Horton
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1964-1987



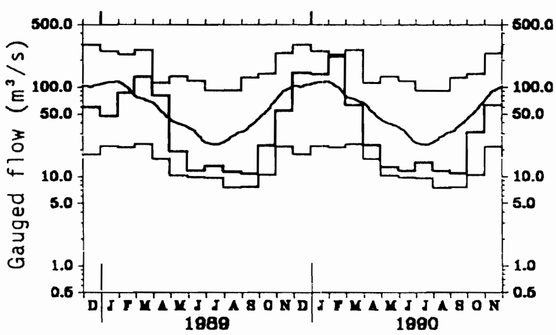
042010 Itchen at Highbridge+Allbrook
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1958-1987



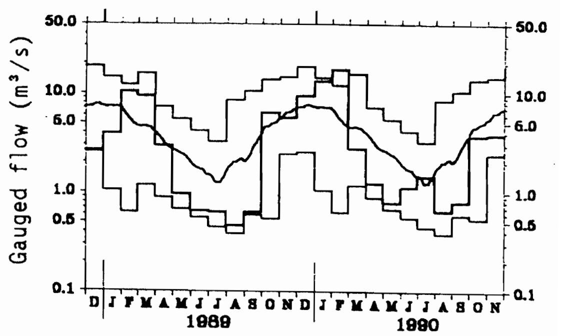
052005 Tone at Bishops Hull
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1961-1987



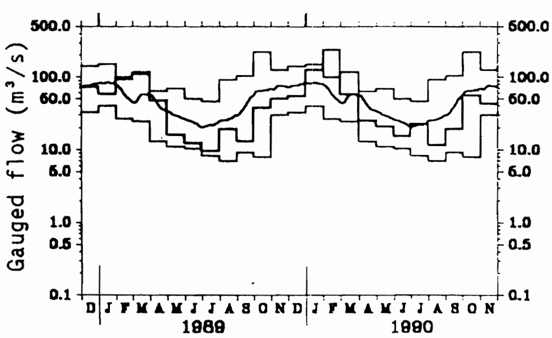
054001 Severn at Bewdley
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1921-1987



057004 Cynon at Abercynon
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1957-1987



076007 Eden at Sheepmount
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1967-1987



084013 Clyde at Daldowie
Monthly mean flows for Dec 1988-Nov 1990
+ extremes and 30 day running mean for 1963-1987

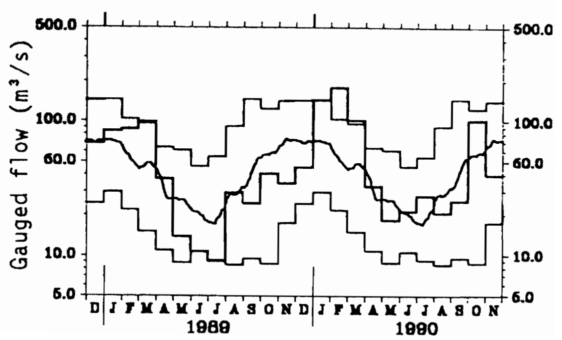
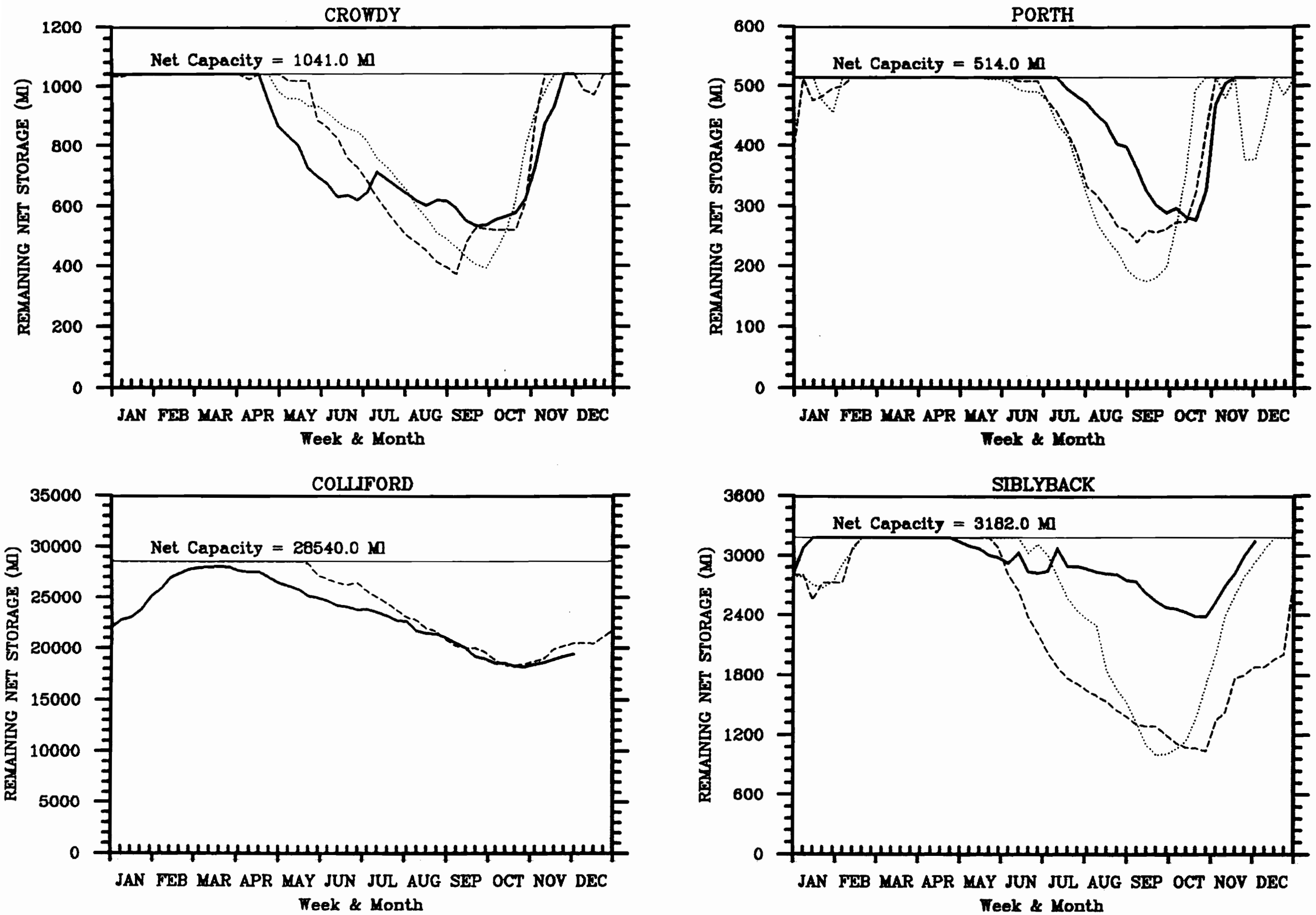


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

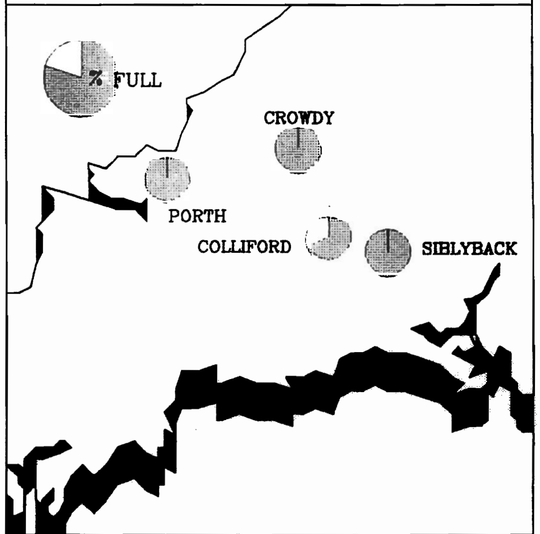
River/ Station name	Jun 1990	Jul	Aug	Sep	Oct	Nov 1990		9/90 to 11/90		4/90 to 11/90		12/89 to 11/90		5/89 to 11/90	
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at	28	37	18	23	78	61	9	162	7	303	3	693	4	895	1
Park	75	134	55	54	97	82	/19	82	/18	70	/18	89	/18	77	/17
Tay at	40	46	31	41	124	80	10	245	12	499	9	1445	38	1872	31
Ballathie	89	116	60	58	111	67	/39	81	/38	84	/38	129	/38	114	/37
Whiteadder Water at	7	14	6	8	62	43	14	114	15	157	8	269	3	326	2
Hutton Castle	39	109	37	50	235	116	/22	140	/22	82	/21	68	/21	59	/20
South Tyne at	16	17	9	23	88	52	7	163	8	247	2	764	14	908	4
Haydon Bridge	58	58	22	44	127	57	/29	76	/27	62	/27	101	/27	82	/25
Derwent at	10	8	5	5	9	16	6	29	2	72	1	170	1	228	1
Buttercrambe	59	60	36	38	39	64	/18	49	/17	45	/17	51	/17	49	/16
Trent at	11	10	9	9	14	21	11	44	6	101	1	297	7	390	2
Colwick	57	62	53	53	59	68	/33	63	/32	57	/32	83	/32	77	/31
Dove at	15	13	10	11	22	44	14	77	8	154	3	398	4	523	2
Marston on Dove	57	57	43	45	66	92	/30	73	/28	60	/28	80	/28	73	/26
Lud at	11	9	8	8	8	7	3	22	3	76	2	141	3	205	3
Louth	53	54	58	70	65	47	/23	59	/23	53	/22	53	/22	55	/21
Bedford Ouse at	5	4	3	3	8	5	15	16	16	43	12	221	28	271	26
Bedford	61	67	58	60	79	25	/58	45	/58	49	/58	101	/57	95	/57
Colne at	4	2	2	2	3	5	7	10	5	30	3	99	4	130	4
Lexden	73	47	49	47	35	40	/32	41	/31	49	/31	72	/31	70	/30
Mimram at	8	7	6	5	5	5	2	15	4	58	5	108	11	160	6
Panshanger Park	73	72	67	62	60	57	/38	61	/38	73	/38	85	/38	83	/37
Thames at	8	6	5	5	6	6	6	17	6	63	11	232	46	290	39
Kingston (natr.)	63	63	57	56	45	28	/108	39	/108	55	/108	94	/107	86	/107
Blackwater at	12	10	9	9	12	12	6	33	4	98	6	285	20	376	16
Swallowfield	81	87	78	68	61	49	/39	57	/38	71	/38	109	/38	99	/37
Coln at	17	14	12	10	10	8	1	28	2	129	3	395	12	505	8
Bibury	63	66	71	70	61	33	/28	52	/27	67	/27	100	/27	92	/26
Great Stour at	11	8	7	6	11	19	12	37	6	89	1	205	4	271	2
Horton	70	56	51	43	53	71	/27	59	/26	58	/24	68	/23	63	/23
Itchen at	30	23	21	20	21	22	2	63	3	220	4	423	8	591	5
Highbridge+Allbrook	86	75	74	76	69	64	/33	70	/32	81	/32	91	/32	85	/31
Stour at	10	6	5	5	8	10	4	23	2	80	2	423	9	499	7
Throop Mill	63	53	47	42	37	32	/18	36	/18	51	/18	107	/17	95	/17
Piddle at	17	13	9	8	12	13	4	33	2	130	2	392	11	497	9
Baggs Mill	72	72	57	52	58	44	/28	52	/27	67	/27	97	/26	89	/25
Exe at	11	20	10	10	44	90	16	144	9	217	3	741	11	945	5
Thorverton	46	97	35	25	58	94	/35	69	/35	58	/34	89	/34	82	/34
Tone at	9	8	6	7	8	16	5	31	2	84	1	471	14	568	10
Bishops Hull	50	51	48	45	29	38	/30	37	/30	43	/30	99	/29	89	/29
Severn at	7	9	7	6	19	37	29	63	15	107	4	443	32	529	15
Bewdley	40	63	40	27	56	69	/70	58	/70	50	/70	98	/69	83	/69
Teme at	10	9	7	7	9	20	8	36	6	91	2	435	17	483	8
Knightsford Bridge	70	109	80	83	44	60	/21	59	/21	61	/21	117	/20	99	/20
Cynon at	28	37	16	19	94	94	12	208	9	338	4	1370	20	1752	14
Abercynon	69	109	32	28	77	61	/33	60	/31	56	/31	110	/31	99	/29
Dee at	50	59	36	66	222	198	10	486	8	728	3	1777	10	2326	4
New Inn	85	87	38	48	111	81	/22	84	/22	74	/21	98	/21	86	/20
Lune at	15	68	12	36	142	73	5	251	8	417	3	1139	12	1454	5
Caton	37	132	17	41	116	54	/28	74	/28	67	/28	101	/26	86	/26
Clyde at	29	39	29	35	143	54	8	232	13	399	14	1030	27	1255	19
Daldowie	110	146	71	60	177	56	/28	100	/27	99	/27	136	/27	111	/26

Notes (i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1;
(iii) %LT means percentage of long term average from the start of the record to 1989. For the long periods (at the right of this table), the end date for the long term is 1990.

FIGURE 3 EAST CORNWALL RESERVOIR LEVELS FOR 1990 AND HISTORIC DROUGHT YEARS



Fowey District Reservoirs



RESERVOIR SITUATION AT
03/12/90
WEEK NO 48

	NET CAPACITY (Ml)	WEEK NO 48 CURRENT YEAR 1990 (Ml)	% Full	HISTORIC DROUGHT YEARS 1976 (Ml)	% Full	1989 (Ml)	% Full
COLLIFORD	28540.0	19489	68	N/A	N/A	20577	72
CROWDY	1041.0	1041	100	1041	100	1041	100
PORTH	514.0	514	100	377	73	514	100
SIBLYBACK	3182.0	3147	99	2933	92	1882	59

1976 Drawdown — 1989 Drawdown — 1990 Drawdown

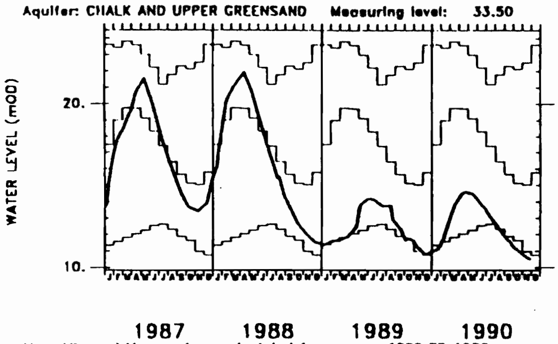
Indicates a Drought year

SOUTH WEST WATER

FIGURE 4 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

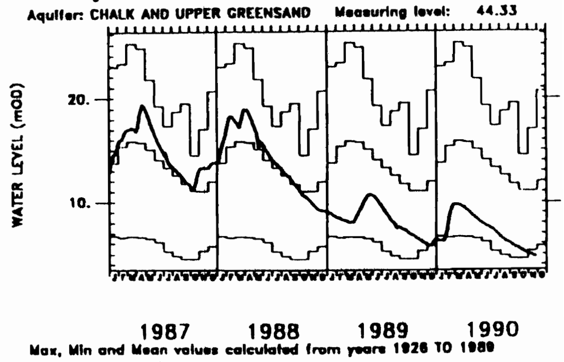
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 33.50



Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

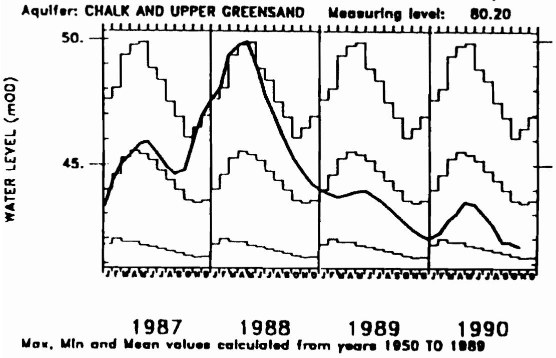
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 44.33



Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

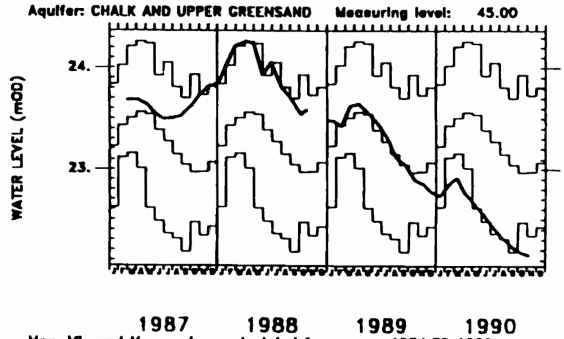
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



Max, Min and Mean values calculated from years 1950 TO 1989

Site name: FAIRFIELDS

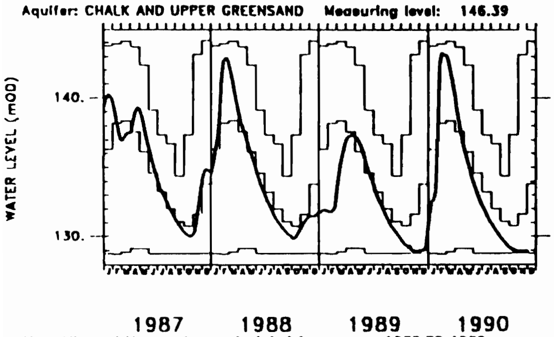
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00



Max, Min and Mean values calculated from years 1974 TO 1989

Site name: ROCKLEY

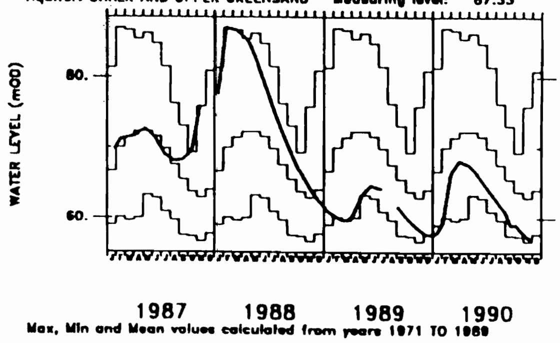
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.39



Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

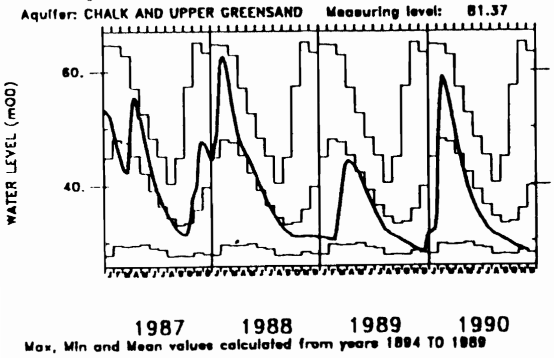
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



Max, Min and Mean values calculated from years 1971 TO 1989

Site name: COMPTON HOUSE

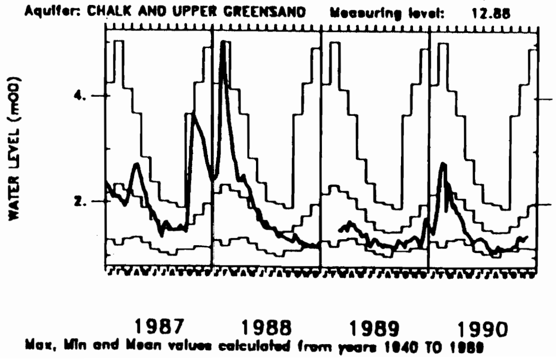
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST DEAN NO.3

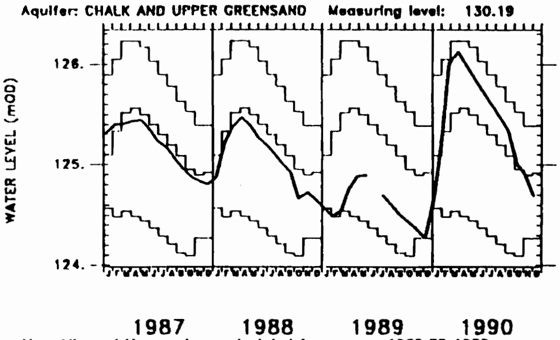
National grid reference: TV 5290 9920 Well number: TV59/7C
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 12.88



Max, Min and Mean values calculated from years 1940 TO 1989

Site name: LIME KILN WAY

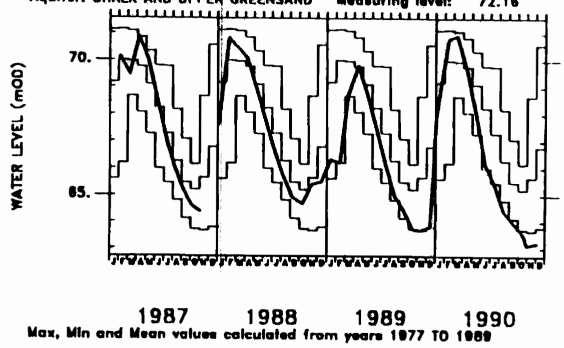
National grid reference: ST 3763 0667 Well number: ST30/7
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 130.19



Max, Min and Mean values calculated from years 1969 TO 1989

Site name: ASHTON FARM

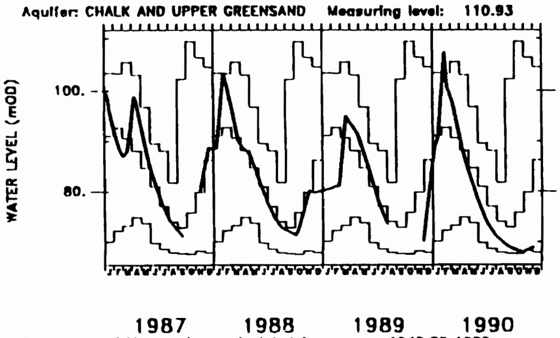
National grid reference: SY 6620 8810 Well number: SY68/34
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 72.16



Max, Min and Mean values calculated from years 1977 TO 1989

Site name: WEST WOODYATES MANOR

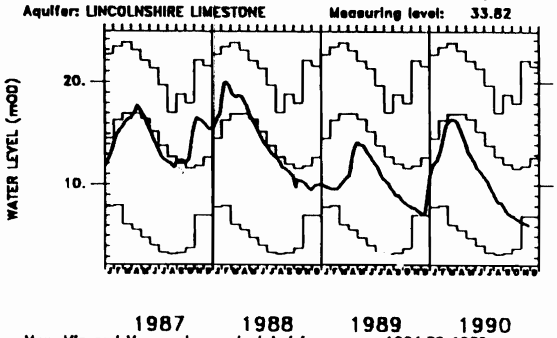
National grid reference: SU 0160 1960 Well number: SU01/58
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.93



Max, Min and Mean values calculated from years 1942 TO 1989

Site name: NEW RED LION

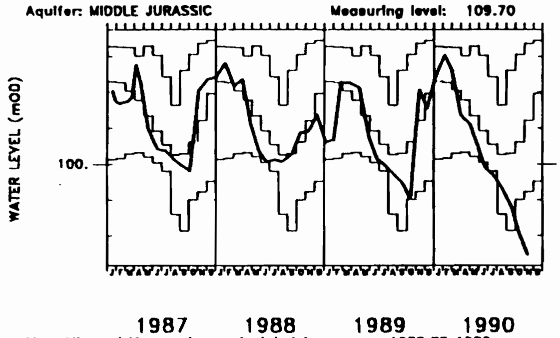
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

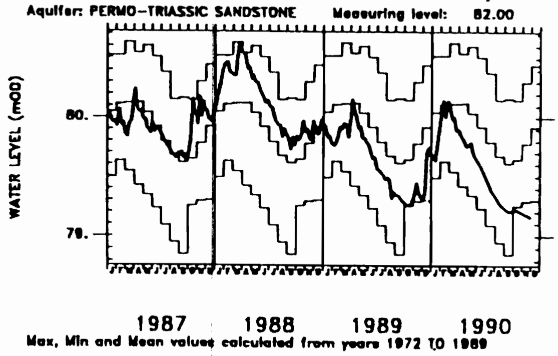
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.70



Max, Min and Mean values calculated from years 1958 TO 1989

Site name: LLANFAIR DC

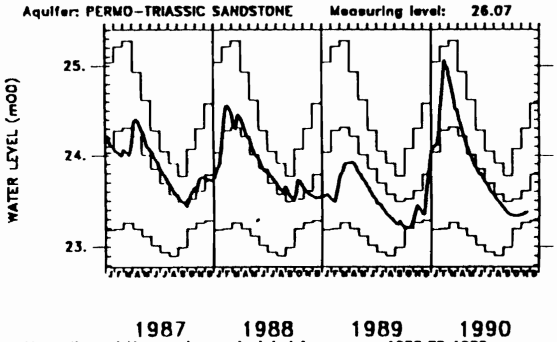
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 82.00



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: BUSSELS NO.7A

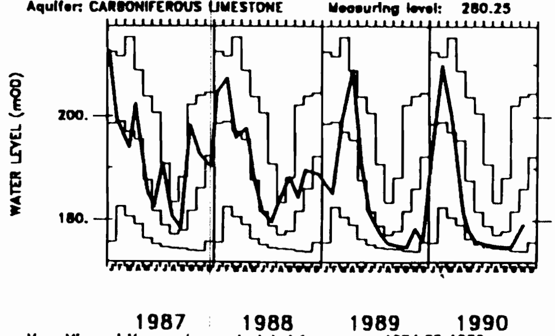
National grid reference: SX 9528 9872 Well number: SX99/378
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.07



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16
Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25



Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 4 A COMPARISON OF NOVEMBER GROUNDWATER LEVELS: 1990 AND 1976

Borehole	Aquifer	First year of record	Av. Nov level	Nov 1976 Day	Nov 1976 level	Nov 1990 Day	Nov 1990 level	No. of years of record with Nov levels ≤ 1990	Lowest recorded level before 1990 for any month
Dalton Holme	C & U.G.	1889	15.04	27	15.07	29	10.49	0	10.73
L. Brocklesby	"	1926	11.03	26	7.09	27	4.76	0	4.56
Washpit Farm	"	1950	43.43	01	41.50	01	41.66	4	41.24
Rockley	"	1933	131.57	-	Dry	-	Dry	5	dry
Compton House	"	1894	35.68	25	38.00	27	28.39	1	27.64
L. Bucket Farm	"	1971	62.91	01	56.77	26	57.09	1	56.77
West Dean	"	1940	1.76	26	2.13	30	1.39	19	1.01
Limekiln Way	"	1969	124.89	15	124.42	07	124.90	9	124.09
Fairfields	"	1974	22.97	30	23.08	08	22.15	0	22.18
Ashton Farm	"	1977	65.73	25	68.85	01	63.10	0	63.23
Ampney Crucis	M.J.	1958	101.21	25	101.86	12	97.48	0	97.80
New Red Lion	L.L.	1964	11.86	26	10.06	11	6.10	0	3.29
Llanfair D.C.	PTS	1972	79.75	01	79.47	12	79.19	0	79.25
Bussels 7A	"	1972	23.60	30	24.30	21	23.37	6	22.90
Alstonfield	C.B.	1974	186.07	25	182.89	16	179.08	6	174.22

Groundwater levels are in metres above Ordnance Datum

C & U.G. Chalk and Upper Greensand;
L.L. Lincolnshire Limestone
PTS Permo-Triassic Sandstones
M.J. Middle Jurassic Limestone
C.B. Carboniferous Limestone

FIGURE 5 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS